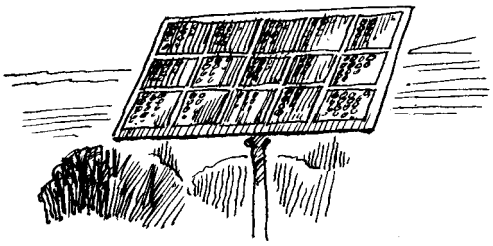
# Solar Energy



EPA's State and Local Climate Change Program helps build awareness, expertise, and capacity to address the risk of climate change at the state and local levels. The program provides guidance and technical information to help state and local agencies prepare inventories of greenhouse gas emissions, develop action plans to reduce emissions, and educate their constituents. By emphasizing the many economic and environmental benefits of greenhouse gas reductions, the program encourages state and local decisionmakers to implement voluntary measures to reduce their greenhouse gas emissions.

## Energy from the Sun

Each day more solar energy hits the Earth than the total energy that the 5.9 billion inhabitants of the planet would consume in 27 years. Clean energy from the sun can replace power sources that pollute the environment. The few emissions of greenhouse gases or air pollutants generated by solar energy technologies occur mostly during the manufacturing process. A 100-megawatt solar thermal electric power plant, over its 20-year life, will avoid more than 3 million tons of carbon dioxide ($CO_2$) emissions when compared with the cleanest conventional fossil fuel-powered electric plants available today.

Solar energy technologies are divided into two major kinds: photovoltaic (PV) cells and modules, which convert sunlight directly into electricity; and solar thermal technologies, which collect solar heat energy for direct heating of space and water and indirect production of electricity. Photovoltaic devices, first used in the space program, generate electricity to power residences, satellites, highway signs, communication stations, navigation buoys, streetlights, calculators, and more. Building-integrated solar products such as solar roof shingles and opaque glass PV façades also are now available on the market. In the last seven years, worldwide photovoltaic sales have nearly tripled.

Photovoltaic arrays can be combined to create large-scale PV power plants. The Sacramento Municipal Utility District in California operates a 1,600-module, 2 megawatt photovoltaic power plant that produces enough electricity to serve 660 homes in the Sacramento area.

Solar thermal power is the least costly form of solar electricity for grid-connected applications today. Concentrating solar power technologies—parabolic troughs, power towers, and dish/engine systems—convert sunlight into electricity efficiently and with minimum effect on the environment.

Other uses of thermal energy from the sun include solar water heating for buildings and swimming pools, and solar space heating and cooling systems for buildings.

Passive solar systems involve the collection and storage of solar energy through building design and siting, and through technologies that capture and retain solar heat energy such as "smart" windows, trombe walls, flooring and other materials that serve as thermal mass to absorb and re-radiate solar heat, and evaporative cooling systems.

Solar energy technologies offer a clean, renewable, and domestic energy source. During operation, solar energy systems produce no air pollution, hazardous waste, or noise, and they require no transportable fuels. The domestic solar energy industry also creates new high-tech jobs.

Solar energy technologies emit no greenhouse gases during operation, but the energy used to make, transport, and assemble them results in some emissions. In general, however, the life-cycle greenhouse gas emissions associated with any solar power technology are nominal compared with those of fossil fuel power plants.

### The Federal Role

The U.S. Department of Energy's Million Solar Roofs Initiative will bring solar energy to a million public and private U.S. rooftops by 2010. To do its part to meet that goal,

the federal government has committed to placing 20,000 solar energy systems on federal buildings.

The Million Solar Roofs Initiative will work with public and private partners to remove market barriers to solar energy use and to develop and strengthen demand for solar energy products and applications. In 2010, the program will offset annual $CO_2$ emissions by an amount equal to that produced by 850,000 automobiles and will produce the same electricity generating capacity as 3-5 coal-fired power plants. The Million Solar Roofs Initiative also will create approximately 70,000 new jobs by 2010 as a result of new demand for solar technologies.

The U.S. Department of Energy's TEAM-UP program (Building Technology Experience to Accelerate Markets in Utility Photovoltaics) continues the government's momentum on solar energy through technology validation and through cost-shared partnerships with state and local governments, energy service providers, the solar energy industry, developers, and builders.

A 10 percent federal income tax credit is available for businesses that invest in or purchase solar energy technology. The Energy Policy Act of 1992 extended this tax credit with no expiration date.

## State Successes with Solar Energy

To date, almost 30 states have some type of incentive for installing residential or commercial solar systems. On the local level, a growing number of communities promote the use of solar energy technologies. For example, the Solar Explorer Program in Austin, Texas, allows residents to sponsor solar projects such as a 32-kilowatt photovoltaic rooftop system on one of the city's park-and-ride covered lots.

### *Colorado*

With funding from the Colorado Office of Energy Conservation, all six homes featured in metropolitan Denver's 1998 Parade of Homes included renewable and energy-efficient technologies, such as solar hot-water heating and photovoltaic systems. Two of the homes featured closed-loop solar hot water heating systems consisting of two 4- by 8-foot panels and an 80-gallon storage tank.

Each of the hot water systems should displace about 3,760 kilowatt-hours of electricity annually for a family of four, avoiding approximately 5,170 pounds of carbon dioxide per year.

### *Florida*

The Florida State Energy Office and Sandia National Laboratories funded a photovoltaic demonstration project in Lakeland, Florida, during the summer of 1998. The project compared the energy use of a conventional home with an adjacent house designed to use solar-generated electricity to provide most of its cooling needs. The solar house used a number of features to reduce cooling loads, including a white reflective roof, insulation, wider overhangs, solar-controlled windows, and a high-efficiency air conditioning system. Daytime electricity was generated by a 4-kilowatt photovoltaic array installed on the south and west sides of the building.

The conventional home used about 61.2 kilowatts per day of electricity in June 1998, amounting to 122 pounds of $CO_2$ emissions per day or 44,000 pounds per year. The solar home used only 14.7 kilowatts per day, most of which was generated by the photovoltaic system.

### BENEFITS OF SOLAR ENERGY

- Clean energy with no emissions or noise pollution.
- Low operating and maintenance costs.
- Emissions from manufacturing and construction are quickly offset.
- Reliable systems, useful for grid-connected and remote applications.
- Modular systems that can be constructed to any size.
- Creation of new jobs.

## For More Information

DOE's *National Center for Photovoltaics,* headquartered at National Renewable Energy Labs in Boulder, Colorado, is a comprehensive information source on PV technologies.
Tel: 303-275-3000
Website: *http://www.nrel.gov/ncpv/*

The *Federal Energy Management Program* provides information on federal programs to promote solar technologies.
Tel: 800-DOE-EREC (363-3732)
Website: *http://www.eren.doe.gov/femp*

The *Center for Renewable Energy and Sustainable Technology* provides educational tools and information on renewables.
Website: *http://solstice.crest.org*

EPA's *Solar Site* describes the agency's five-point solar initiative and includes a link to EPA's pollution prevention calculator, which allows individuals to calculate the emissions avoided by using photovoltaics or solar water heaters.
Website: *http://www.epa.gov/solar*

The *American Solar Energy Society* is a national organization dedicated to advancing the use of solar energy for the benefit of U.S. citizens and the global environment.
Website: *http://www.ases.org*

The *Million Solar Roofs Initiative* is working with state and local partnerships across the country to overcome barriers and facilitate the installation of one million rooftops across the United States by 2010.
Website: *http://www.MillionSolarRoofs.org*

The *Solar Energy Research and Education Foundation* develops and disseminates educational material on solar and other alternative energy sources.
Website: *http://www.seref.org*

The *Utility PhotoVoltaic Group* (UPVG) is a national organization representing utilities, new energy service providers, and PV equipment manufacturers and integrators. The UPVG currently manages DOE's TEAM-UP program.
Website: *http://www.upvg.org*

EPA's *State and Local Climate Change Program* helps states and communities reduce emissions of greenhouse gases in a cost-effective manner while they address other environmental problems.
Website: *http://www.epa.gov/globalwarming/ and click on "Public Decision Makers" under the "Visitors Center."*